

REMARKS

Claims 1-2 are pending and stand ready for further action on the merits. Claims 3-4 have been amended to more clearly define the layers using the identifiers "A", "B" and "C". Support for claim 2 can be found in claim 2. No new matter has been added by way of the above-amendment.

The following sections correspond to the sections in the outstanding Office Action.

Sections 3-4

The Examiner objects to claim 2 for reciting a "second layer" initially in line 2 and then in line 4 "a first layer". In addition, the Examiner objects to claim 5 for reciting a "second" and "third" layer without referring to a "first" layer.

In response, Applicants have amended claims 2-5 by replacing the references to the "first", "second", and "third" layers with the identifiers "A", "B" and "C". As noted, the amended claim 2 now recites "a first layer" and the amended claim 5 now recites "A", "B" and "C" layers. The Examiner's objection is hereby withdrawn.

the semiconductor structure is not necessarily limited to different layers.

In view of the foregoing, Applicants respectfully request that the Examiner's objection be withdrawn.

Sections 5-8

Claims 1-6 and 8 are rejected under 35 U.S.C. 102(e) as being anticipated by Iyechika et al. (U.S. Patent 6,023,077); and claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Iyechika et al. Applicants respectfully traverse the rejections.

Advantages of the Present Invention:

The inventive group III-V compound semiconductor of the general formula $\text{In}_x\text{Ga}_y\text{Al}_z\text{N}$ is formed with the concentration of the p-type dopant in a range of $1 \times 10^{17} \text{ cm}^{-3}$ to $1 \times 10^{19} \text{ cm}^{-3}$. By obtaining the p-type dopant concentration within this range, it is possible to improve the p-type carrier concentration with low defect density and to obtain high crystallinity when the layer is formed with a liquid epitaxial method. Thus, a semiconductor structure with high crystallinity

Experimental evidence of this fact can be seen in the examples and comparative examples of the present specification.

Iyechika et al.

Iyechika et al. teach a light emitting device having the atomic formula $\text{In}_x\text{Ga}_y\text{Al}_z\text{N}$ ($x+y+z=1$, $0 \leq x \leq 1$, $0 \leq y \leq 1$, $0 \leq z \leq 1$). In order to find the present semiconductor unpatentable, the Examiner cites the disclosure at column 2, lines 44+; column 5, lines 17-19; and column 8, lines 1-14 of Iyechika et al.

However, upon careful review of the sections cited by the Examiner, Applicants could not find the teachings of Iyechika et al. which anticipate or make obvious the presently claimed semiconductor or light emitting device. The Examiner is respectfully requested to elaborate on his position in the next communication.

Applicants respectfully submit that it appears that this reference is silent with respect to the advantages of maintaining the p-type conductivity throughout within the substrate layer. In addition, Iyechika et al. are silent with respect to the specific concentration of the p-type dopant in the lower layer or substrate.

semiconductors, it appears that the Examiner has taken the position that the semiconductors prepared in the examples of Iyechika et al. inherently have a p-type dopant concentration that falls within the inventive range of $1 \times 10^{15} \text{ cm}^{-3}$ to $1 \times 10^{16} \text{ cm}^{-3}$.

Applicants respectfully submit that the courts have not taken a similar position in similar cases. In *In re Pearson*, 181 USPQ 641 (CCPA 1974), the inherency issue involved a limitation of a composition used in a claimed process. The process inhibited the formation of small and malformed peanuts during the growth of peanut crops by applying a particular composition to the foliage of the crops. The composition contained a calcium-containing compound having a "sufficiently small particle size to substantially reduce the formation of pops and unsound kernels." The cited prior art taught a process that involved spreading an inorganic salt on the ground surrounding the peanut plant. The court reversed the rejection of the claims reciting the use of a particular calcium compound because, in the prior art, the composition used in the process was not an inorganic salt. *In re Pearson*, 181 USPQ 641.

It appears that the Examiner has taken a similar position in

the prior art. See *Ex parte Levy*, 17 USPQ2d 1461, 51 ALR 1227, 390 F.2d 1041 (CCPA, 1968), cert. denied, 394 U.S. 978 (1969). The Board held that an analogy **must** flow as a necessary conclusion from the prior art, not simply a possible one.

Since there is no teaching that the semiconductor of Iyechika et al. has a p-type dopant concentration that falls within the inventive range of $1 \times 10^{17} \text{ cm}^{-3}$ to $1 \times 10^{18} \text{ cm}^{-3}$, Applicants respectfully submit that the rejection is not tenable. As such, Applicants respectfully request that the rejection be withdrawn.

Drawings

On June 13, 2002, Applicants amended the specification to include one sheet of drawings. However, the Examiner has not indicated whether this sheet of drawings is acceptable. The Examiner is respectfully requested to acknowledge whether this sheet of drawings is acceptable.

Notice of References Cited (PTO-892 Form)

From the PTO-892 Form enclosed with the most recent communication, Applicants note that the Examiner has not listed any references. Accordingly, the Examiner is requested to acknowledge whether any references have been cited.

Applicants respectfully request that the Examiner clarify the reasons why he has cited Sugita et al. and Yamura et al. Also, Applicants respectfully request that the Examiner clarify why he has cited Sugita et al. and Yamura et al.

Information Disclosure Statements (IDS)

The Examiner is respectfully requested to forward initialed and signed copies of the PTO-1449 forms which were enclosed with the IDS filed September 12, 2002 **and** the IDS filed September 24, 2002.

Conclusion

In view of the above-amendments and comments, Applicants respectfully submit that the claims are in condition for allowance. A notice to such effect is earnestly solicited.

Pursuant to the provisions of 37 C.F.R. §§ 1.17 and 1.136(a), the Applicants hereby petition for an extension of three (3) months to January 1, 2003, in order to file a reply to the Office Action. The requested extension is based on the following reasons:

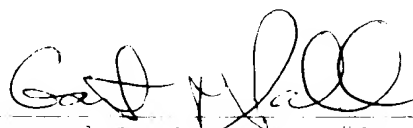
If the Examiner has any questions concerning this application, he is requested to contact Keith M. Ladd, III, #42,000 at the address of the Applicant, 1000 1st Street, N.W., Washington, D.C. 20004.

employment to Deposit Account No. 2244- for any additional fees
required under 45 C.F.R. § 1.15 or under 45 C.F.R. § 1.17;
particularly, extension of time fees.

Respectfully submitted,

BIRCH, STEWART, KOLASCH & BIRCH, LLP

By

 #43575
for Raymond C. Stewart, #21,066

RCS/GMD/gh
2165-0589P

P.O. Box 747
Falls Church, VA 22040-0747
(703) 205-8000

Attachments: Version with Markings to Show Changes Made

IN THE SPECIFICATION:

Line 1 of page 1 has been amended as follows:

Line 2 of page 1 has been amended as follows:

The second paragraph beginning on page 12 and ending on page 13 has been amended as follows:

--For example, in this 3-5 group compound semiconductor, a light emitting layer, n-type layer, low carrier concentration layer and p-type layer are adjacent in this order. For efficient recombination and light emission of injected charges, it is preferable that the [band] bending of an n-type layer is larger than that of a light emitting layer. In a region between an n-type layer and a light emitting layer, preferably, about 100 nm, more preferably, 10-50 nm, it is preferable that thickness of an n-type layer is 10-100 nm. A light emitting layer is preferably 10-100 nm.

film thickness of a low carrier concentration layer is lower than 10 Å and when larger than 1 μm. Further, the light emitting efficiency of a low carrier concentration layer is 1 Å or more and 1 μm or less. The light emitting efficiency of a light emitting device may decrease both when the film thickness of a low carrier concentration layer is lower than 10 Å and when larger than 1 μm.

IN THE CLAIMS:

The claims have been amended as follows:

Claim 2. (Amended) A 3-5 group compound semiconductor having a structure in which a [second] layer (B) composed of a 3-5 group compound semiconductor represented by the general formula $\text{In}_u\text{Ga}_v\text{Al}_w\text{N}$ ($u+v+w=1$, $0 < u < 1$, $0 < v < 1$, $0 < w < 1$) is adjacent to a [first] layer (A) composed of a 3-5 group compound semiconductor represented by the general formula $\text{In}_x\text{Ga}_y\text{Al}_z\text{N}$ ($x+y+z=1$, $0 < x < 1$, $0 < y < 1$, $0 < z < 1$), wherein the concentration of acceptor impurities in the [second] layer is 1×10^{17} cm⁻³ or less, wherein the concentration of acceptor impurities in the [first] layer is 1×10^{17} cm⁻³ or more and 1×10^{19} cm⁻³ or less, and the thickness is larger than the thickness of the [second] layer (B).

Claim 3. (Amended) A 3-5 group compound semiconductor having a structure in which a layer (A) composed of a 3-5 group compound semiconductor represented by the general formula $\text{In}_x\text{Ga}_y\text{Al}_z\text{N}$ ($x+y+z=1$, $0 \leq x \leq 1$, $0 \leq y \leq 1$, $0 \leq z \leq 1$) in which the concentration of an n-type carrier is $1 \times 10^{17} \text{ cm}^{-3}$ or less, wherein the concentration of a p-type dopant is $1 \times 10^{17} \text{ cm}^{-3}$ or more and $1 \times 10^{16} \text{ cm}^{-3}$ or less is adjacent to a layer (C) composed of a p-type 3-5 group compound semiconductor represented by the general formula $\text{In}_a\text{Ga}_b\text{Al}_c\text{N}$ ($a+b+c=1$, $0 \leq a \leq 1$, $0 \leq b \leq 1$, $0 \leq c \leq 1$).

Claim 4. (Amended) A 3-5 group compound semiconductor having a structure comprising at least one layer (A) composed of a 3-5 group compound semiconductor represented by the general formula $\text{In}_x\text{Ga}_y\text{Al}_z\text{N}$ ($x+y+z=1$, $0 \leq x \leq 1$, $0 \leq y \leq 1$, $0 \leq z \leq 1$) in which the concentration of an n-type carrier is $1 \times 10^{17} \text{ cm}^{-3}$ or less, wherein the concentration of a p-type dopant is $1 \times 10^{17} \text{ cm}^{-3}$ or more and $1 \times 10^{16} \text{ cm}^{-3}$ or less, between a layer (B) composed of a 3-5 group compound semiconductor represented by the general formula $\text{In}_a\text{Ga}_b\text{Al}_c\text{N}$ ($a+b+c=1$, $0 \leq a \leq 1$, $0 \leq b \leq 1$, $0 \leq c \leq 1$) and a layer (C) composed of a p-type 3-5 group compound semiconductor represented by the general formula $\text{In}_a\text{Ga}_b\text{Al}_c\text{N}$ ($a+b+c=1$, $0 \leq a \leq 1$, $0 \leq b \leq 1$, $0 \leq c \leq 1$).

claim 1. According to claim 1, the semiconductor structure having a structure comprising a [second] layer (B) composed of a 3-5 group compound semiconductor represented by the general formula $\text{In}_u\text{Ga}_v\text{Al}_w\text{N}$ ($u+v+w=1$, $0 \leq u \leq 1$, $0 \leq v \leq 1$, $0 \leq w \leq 1$) carrying thereon a laminated layer (D) composed of an n-type 3-5 group compound semiconductor represented by the general formula $\text{In}_p\text{Ga}_q\text{Al}_r\text{N}$ ($p+q+r=1$, $0 \leq p \leq 1$, $0 \leq q \leq 1$, $0 \leq r \leq 1$) having larger band gap than that of said [second] layer (B), and at least one layer (A) composed of a 3-5 group compound semiconductor represented by the general formula $\text{In}_x\text{Ga}_y\text{Al}_z\text{N}$ ($x+y+z=1$, $0 \leq x \leq 1$, $0 \leq y \leq 1$, $0 \leq z \leq 1$) in which the concentration of an n-type carrier is $1 \times 10^{17} \text{ cm}^{-3}$ or less, wherein the concentration of a p-type dopant is $1 \times 10^{17} \text{ cm}^{-3}$ or more and $1 \times 10^{18} \text{ cm}^{-3}$ or less, between said layer (D) composed of the n-type 3-5 group compound semiconductor and a [third] layer (C) composed of a p-type 3-5 group compound semiconductor represented by the general formula $\text{In}_p\text{Ga}_q\text{Al}_r\text{N}$ ($p+q+r=1$, $0 \leq p \leq 1$, $0 \leq q \leq 1$, $0 \leq r \leq 1$), where the [second] layer (B) and [third] layer (C).

Claim 6. (Amended) The compound semiconductor according to any one of claims 1 to 5 wherein the p-type dopant is Mn and/or Zn.

Claim 7. (Amended) A method of producing a 3-5 group compound semiconductor according to any one of claims 1 to [6] 5, comprising growing a 3-5 group compound semiconductor represented by the general formula $\text{In}_x\text{Ga}_y\text{Al}_z\text{N}$ ($x+y+z=1$, $0 \leq x \leq 1$, $0 \leq y \leq 1$, $0 \leq z \leq 1$) in which the concentration of an n-type carrier is $1 \times 10^{18} \text{ cm}^{-3}$ or less, wherein the concentration of a p-type dopant is $1 \times 10^{17} \text{ cm}^{-3}$ or more and $1 \times 10^{19} \text{ cm}^{-3}$ or less, at temperatures of 600°C or more and 950°C or less according to a metal organic vapor phase growth method.

Claim 8. (Amended) A light emitting device obtained by using a 3-5 group compound semiconductor according to any one of claims 1 to [6] 5.

What is claimed is: